

Finding subglacial water the "ICESat way" in rough terrain

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Satellite data analysis has inferred ongoing storage and release of large water volumes beneath fast flowing portions of West Antarctica. To date most of the inferred occurrences have been derived from repeat-pass laser altimetry. Spatial coverage of the GLAS instrument onboard the ICESat satellite is extensive over West Antarctica and is organized into a set of repeat tracks that have been remeasured three times per year since the 2003 launch of ICESat. In reality, however, the tracks are not exact repeats and cross-track offsets can be more than 100 meters horizontally. These offsets lead to elevation differences if there is a sloping surface between near-repeat tracks. In areas of rough terrain, the cross-track slopes can lead to elevation differences of many meters, similar in magnitude to the surface expressions of moving subglacial water, confounding identification of subglacial water movement events. GLAS data have been used to calculate and correct for the cross-track slope, but this is problematic if there are shifts in the elevation caused by water movement and not exclusively due to static topographic variation.

In this work, we describe the use of satellite optical imagery (Landsat in our case) to provide an independent measure of the cross-track slope. This technique enables the elevations of near-repeat profiles to be corrected to a common reference track and should lead to less ambiguous identification of temporal changes in surface elevation. The technique has multiple applications, including the class of temporal events associated with subglacial water movement but also the objective of identifying and quantifying sustained thickening or thinning of the ice sheet.